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Mr. Swift, the Merope Nebul.

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If Messrs. Hough and Burnham will contract the aperture of their telescope to from 4 to 6 inches, and use a power of about 30, they will see as a reality what they now believe to be a myth.

Rochester, N.Y.:
1881, December 2.

Observations of Venus in the Spring of 1881.

By W. F. Denning, Esq.

In the months of March and April 1881 *Venus* became a splendid object in the evening sky, and I undertook a series of observations chiefly in those months, with a view to recover the delicate markings recorded by some earlier observers. The first observation was made on December 10, 1880, but the planet was near the horizon, and her diameter only $13''\cdot 8$, so that nothing definite was seen.

1880, December 20, $3^h\ 40^m\text{--}4^h\ 5^m$.—*Venus* well defined with power 200. There were spots of the most certain character, though extremely faint.

1881, January 6, $3^h\ 50^m\text{--}4^h\ 5^m$: power 200.—Some minute markings or centres of shading, apparently giving the surface a mottled aspect, just barely discerned. A few light specks were apparent towards the circular contour of the W. limb, where the brightness of the disk was very conspicuous.

January 31, 5^h . No dark markings distinguished.

February 16, $5^h\text{--}5\frac{1}{2}^h$.—*Venus* splendidly defined. The N. horn evidently the sharpest. There were cloudy condensations distributed over the planet's surface except around the W. border, where the brightness was very intense. I suspected crater-like objects of very minute type on the terminator, and a shading running from the N. horn about one-third round, and parallel to the bright interior edge of the planet.

March 1, $4\frac{1}{2}^h\text{--}5\frac{1}{2}^h$.—Faint dusky patches again seen, but they were extremely delicate, and only caught during moments of superb definition.

March 22, $5^h\text{--}7^h$.—No distinct spots seen, though at times I suspected minute shadings elongated in latitude between terminator and W. limb. No spots or crater-like objects on the terminator, which is evidently not serrated as some observers have described it. The cusps were markedly bright; so was the surface round the W. limb, but the terminator was much shaded. The rippling appearance of the planet, especially when the air is unsteady, naturally gives the impression of a jagged terminat or and mottled aspect of the entire disk as noted by some observers. But though to-night the planet's disk was very closely examined for detail, these appearances could not be certainly desrcied. The terminator showed some gentle undulations, but there was

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an entire want of that remarkably rugged outline depicted in some sketches.

March 26, 6^h–7^h.—Definition not nearly so good as last night, when the view was nearly perfect. Disk apparently mottled with grey patches and intervening luminous veins or striations, but these may have been due to tremor. I noticed that the cusps were very brilliant and sharp, extending considerably beyond the half-circle, and obviously different from the ordinary Moon-crescent, but in the case of two bodies presumably so distinct in physical characteristics, we cannot expect close agreement. Atmospheric refraction in the case of a planet enveloped in deep and dense air-strata must necessarily diffuse sunlight over a greater area of the surface than in the case of a planet with a non-appreciable atmosphere like the Moon, which can only be illuminated over those parts directly exposed to the Sun. *Venus*, however, would always be reflective more than half hemisphere, and this must cause the anomalous prolongation of the cusps so often noticed and possibly account for the visibility of the whole circle of the planet when near her inferior conjunction.

March 28, 6^h–7^h.—A bright, small spot detected just within N. cusp, and a very faint cloudy area extending from the terminator towards W. limb in S. hemisphere. Also a grey shading in N. hemisphere, running from the terminator. Definition was splendid, power 290, and Barlow lens increasing it to 400, gave excellent views. The mottled aspect of the planet was far less obvious to-night; indeed, I usually find it difficult when definition is good.

March 30, 0^h 30^m.—Definition execrable; indeed, it was invariably found that observations when attempted with the Sun high above the horizon were utterly useless. The atmosphere is too brilliantly illuminated by the Sun's rays and its tremors rendered too strikingly apparent to allow even a lustrous object like *Venus* to be seen with good effect, and it is surprising that such a time is often recommended as eminently suited for such work. We must admit that the glare of *Venus* is considerably moderated in the presence of sunshine, but this effect, though essential in some degree, is brought about by the highly luminous condition of our atmosphere, which unfortunately then reveals its disturbing elements to the utmost degree. During the observation of to-day *two* crescents were seen in the field of view while employing a Kellner comet-eyepiece, power 38, and Barlow lens. There was a large and faint crescent almost central in the field, and a small bright crescent (the real image of the planet) situated slightly to the W. of it. The reputed observations of a satellite of *Venus*, described in astronomical text-books, immediately recurred to me, but it was palpable that the large crescent now seen was a mere spectral appearance. Curiously enough, the two crescents were turned the same way; in fact, one seemed an exact counterpart of the other as regards

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phase. The smaller one was estimated one-sixth the apparent diameter of the larger. The eyepiece was rotated without any displacement in the relative positions of the objects and then removed from the instrument. On looking into the tube at the small diagonal plane, the explanation became obvious. The sunshine streaming into the main aperture of the telescope fell partially upon the small sliding tube carrying the eyepiece, and formed a bright crescent upon the west side, this being feebly reflected in an inverted form through the eyepiece, and thus the "ghost" was originated. The explanation was extremely simple, and I have no doubt that the alleged observations of a satellite of *Venus* made in the last century were capable of a similar solution—indeed, it is hard to think that the origin of such illusions can escape discovery if carefully sought after.

March 30, 6 $\frac{1}{2}$ ^h–7^h.—Bright spot still at N. horn, and the cloudy diffused spot over S. hemisphere. The terminator evidently undulatory in its real figure, and I carefully noted it with power 400. There was a dark notch in it near N. horn, and near the bright spot before alluded to. The latter is extremely small, and looks like a crater, though I could not be certain of this.

March 31, 6 $\frac{1}{4}$ ^h–6 $\frac{3}{4}$ ^h.—Appearance of *Venus* somewhat similar to that depicted last night, except that the markings appeared to have gone slightly westward. The bright spot and dark notch near the N. horn were again seen, though the former was not so distinct as on the previous nights. Definition was good with 200 and 290, and very fair with 400.

April 1, 0^h 30^m.—Observed *Venus*, but definition was very unsatisfactory, and no details could be made out. The spectral crescent was again seen as on March 30.

April 2.—High wind, but the sky very clear. *Venus* could not be observed with high powers owing to the constant vibrations of the telescope.

April 5, 6^h–6 $\frac{1}{2}$ ^h.—The crescent evidently much narrower. There is a faint shading over the apparent N. hemisphere and an indentation at N. cusp, which is very plain, though to-night it appears further from the extremity of the cusp than on the 30th and 31st, but it may not be identical. I strongly suspected the disk to be variegated with alternating light and grey markings, and the terminator to show minute bright specks. I repeatedly had the impression of one situated between the N. cusp and centre of terminator. It looked like a longish curling speck just merging out of the dark contour of the unilluminated hemisphere. The two cusps were notably bright: indeed, their intensity is striking compared with the region near the terminator, which is invariably much shaded. The difficulty in speaking positively as to the mottled or granulated aspect of the planet's disk and the occurrence of craterlike objects on the borders of the terminator arises from two causes—viz. their minute character and the unsteadiness of the image brought about by atmospheric undulations. The surface of the planet

can, it is true, never be viewed absolutely free from that rippling or tremulous motion originated by the continual transit of air-waves across the disk ; and it is not difficult to understand the indistinctness and uncertainty with which minute objects such as these are viewed under the influence of these moisture-laden currents. *Venus* by her excessive lustre is much affected by such phenomena, but some excellent views of this planet may be obtained at about the time of sunset. My own observations indicate that the most suitable period of observation is from half an hour before to half an hour after sunset, when I have usually had no difficulty in obtaining a sharply-defined image of the planet.

Briefly summarising the foregoing results, it would appear that there are dark shadings upon the planet, and light areas with occasional bright spots near the cusps. The latter are very bright : so are the limbs ; while the interior region is less luminous, and there is a gradual shading off towards the terminator, which does not show a distinctly serrated or jagged aspect, though its contour is evidently undulatory, with sometimes an indentation sufficiently obvious to command attention. As to the craterlike objects suspected near the terminator, I believe they are illusory, and caused by the rippling of the telescopic image. It is difficult to conceive that such objects could be perceived upon *Venus*, unless we assume that she has little or no atmosphere, which is impossible, when we consider that the prolongation of the cusps and other phenomena distinctly affirm its existence. There is no doubt that this planet requires very delicate observations, and that her configuration is by no means as devoid of interest as is frequently asserted.

It will be seen by the sketches, and it is a fact I several times noted during my observations, that the positions of the spots compared at similar times on consecutive nights showed a slight movement westward. This approximately confirms the rotation of $23^h 21^m$ given by Cassini and others. The axis appears to be greatly inclined, for the direction of the spots was from about SSE. to NNW. referred to the line of the cusps.

Bianchini, who observed many dark spots on the planet in 1726-7 with a telescope of 66 feet focus and $2\frac{1}{2}$ inches aperture, gave an erroneous rotation period of 24 days 8 hours. But his observations are reliable, though he put a wrong construction upon them. The markings which he noted as occupying the same positions at an interval of 24 days 8 hours had completed 25 circuits around the planet in the meantime. An observer who notes the progressive westerly movement of the spots as compared at nearly the same times on successive nights would certainly infer a period nearly agreeing with that formerly deduced by Bianchini, but when the markings are watched for two or three hours on the same night their swifter motion becomes evident. There are many difficulties, however, in the way of tracing the spots during long and regular periods.

Ashley Down, Bristol :
1881, November 10.